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(54) Adjusting device e.g. for optic fibres or lenses

(57) An adjusting device consists essentially of two angle pieces (3, 5) which fit into one another with a spacing between them, each having a leg (11, 16) extending in parallel with a stationary support (1). The horizontal leg (11) of the lower angle piece (3) is connected to the support (1) via a hinged joint, while a further hinged joint (4) connects vertical legs (12, 13) of both angle pieces (3, 5) to one another.

On the horizontal leg (16) of the upper angle piece (5), the object to be adjusted is disposed either directly or in the receptacle (15) of an adjustable stage (9) mounted on the leg (16), for moving the object in the direction of the Z coordinate. The receptacle (15) is so designed that its centreline is in agreement with that of the object to be adjusted. Moreover, the vertical legs (12, 13) are dimensioned to have such lengths that the swivel axis of their hinged joint (4) lies horizontally in one plane next to the centreline of the object receptacle.

By swivelling both angle pieces (3, 5) about the axis of the lower hinged joint, the object is displaced in the direction of the X coordinate, and by swivelling the upper angle piece (5) about the axis of its hinged joint (4), the object is displaced in the direction of the Y coordinate.

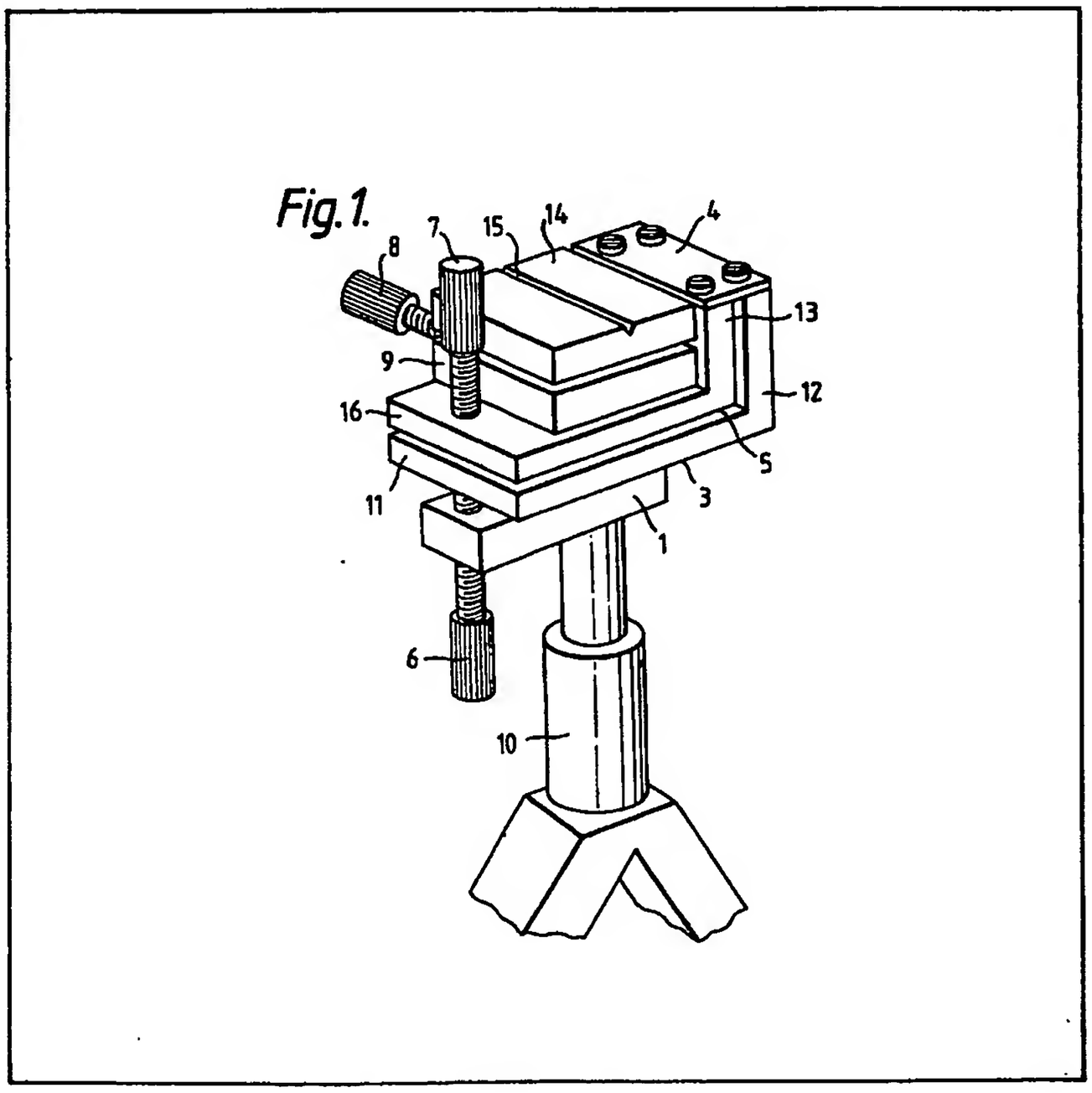

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Fig.1.

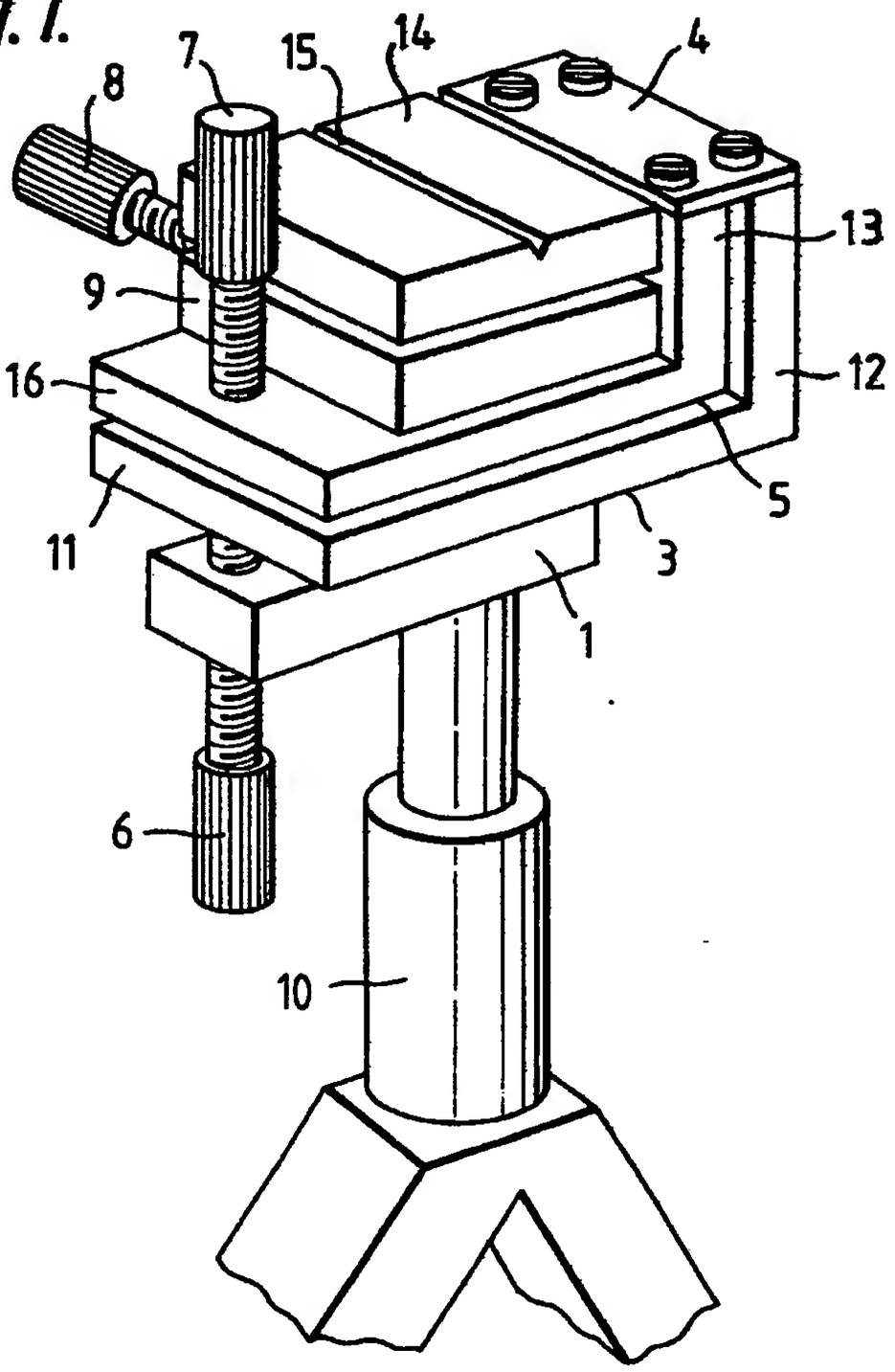


Fig.2.

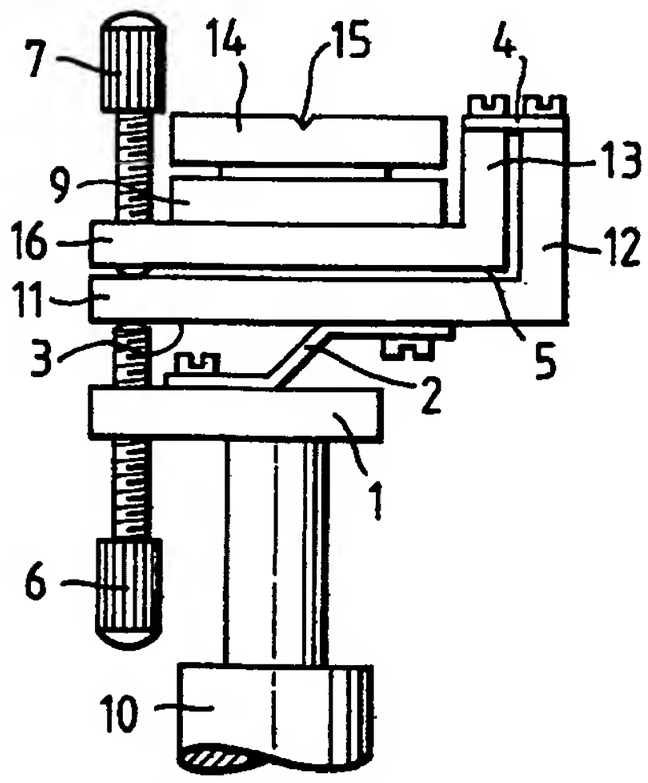


Fig.3.

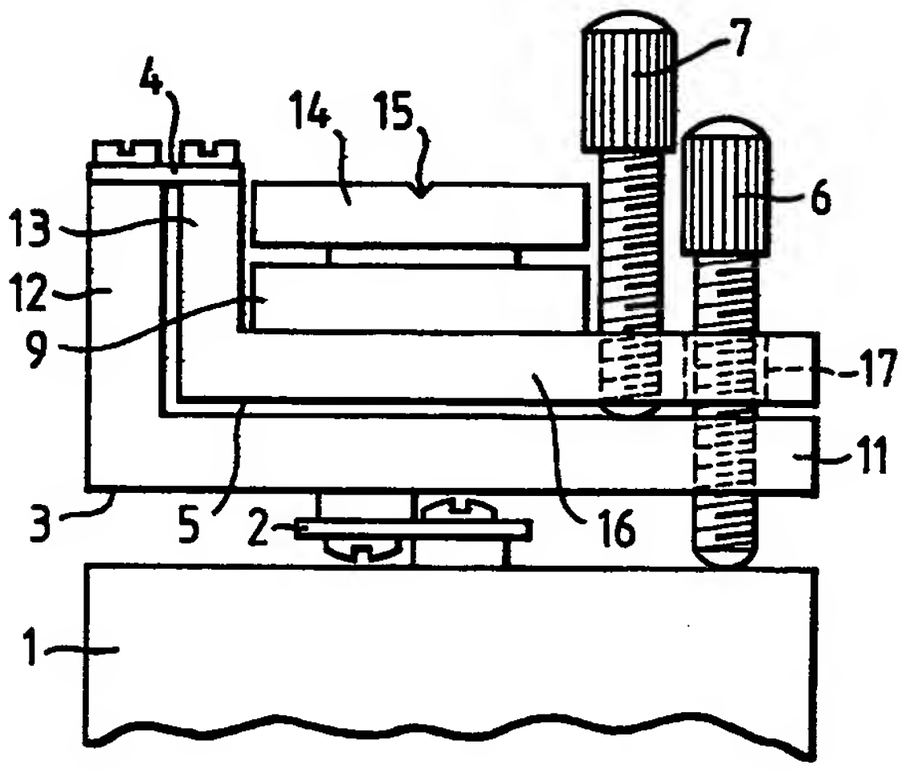
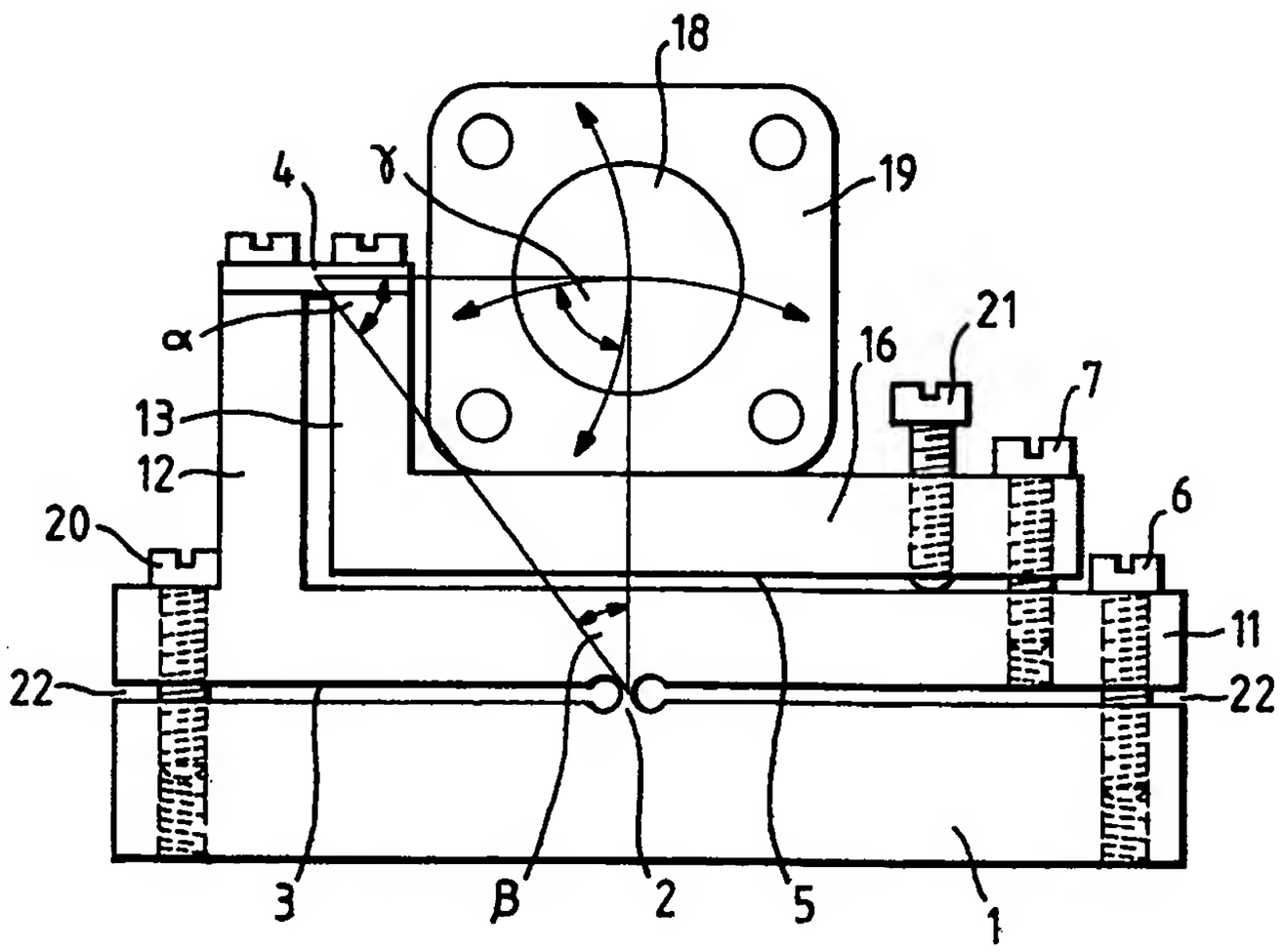

7
4
14
15
6
13
12
9
17
11
3
5
2
16
1

Fig.4.


18
19
γ
4
α
21
16
7
13
12
6
20
11
22
22
3
B
2
5
1

SPECIFICATION

Adjusting device

This invention relates to an adjusting device for the antibacklash displacement of objects (specimens) in a coordinate system having at least two displacement paths, such as for aligning the end faces or longitudinal axes of optoelectronic components and/or optical fibres, of the kind in which the object (specimen) to be positioned is capable of being moved with the aid of adjusting screws, about the axis of a first swivel member lying next to the object (specimen), which swivel member is, in turn, capable of being moved about the axis of a second swivel member mounted in a rocker-like manner on a firm support, lying at a distance in parallel under the object (specimen).

One such adjusting device is known from DE-PS 28 39 753, and consists substantially of a ladder-like frame comprising three crosspieces of which the middle one contains two pivot points on which the first rocker is seated. One rocker end is compresion-spring-loaded so that the other rocker end is pressed resiliently against an adjusting screw seated in a coverplate of the frame. The first rocker is covered by a bridge-like upper part. Between this upper part and the lower part which is likewise provided with pivot points, there is disposed a second rocker containing the object (specimen) to be adjusted, with the one end of this second rocker likewise being compression-spring-loaded and with the other end thereof also being resiliently pressed against the adjusting screw associated therewith, and which is seated in the upper part of the first rocker.

It is an object of the invention to provide an adjusting device of the kind referred to, which is capable of being assembled from as few as possible as well as simple individual parts which, in addition thereto, can be manufactured with relatively large tolerances in a particularly economical manner.

According to the invention in its broadest aspect an adjusting device of the kind referred to is characterised in that the swivel members consist of two angle pieces which fit into one another with a spacing between them, each having a leg extending in parallel with the support, of which the lower leg, via a hinged joint forming the second swivel axis, is connected stationarily to the support, the ends of the respective other leg, via a hinged joint forming the first swivel axis, are connected to one another, and the free leg ends of the angle pieces are each capable of being actuated by an adjusting screw for performing the swivel movements.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows, in a perspective view, a stand-mounted adjusting device with an adjustable stage serving as the specimen slide,

Figure 2 shows, in a front view, the adjusting device according to Figure 1,

Figure 3 shows in a front view, an optical-bench-mounted adjusting device with an adjustable stage, in a modified version and,

Figure 4 shows, in a front view, a further embodiment of the adjusting device with an object to be adjusted disposed directly thereon.

The adjusting device shown in Figures 1 to 4 consists substantially of a rugged support 1, and an angle piece 3 connected to the support via a hinged joint 2, this angle piece 3, in turn, being connected to a further angle piece 5 via a hinged joint 4. Both angle pieces 3, 5 are capable of being separately actuated by a respective adjusting screw 6, 7 with which displacements of an object to be adjusted can be carried out in the direction of the XY coordinates. For displacing (shifting) the object (specimen) in the direction of the Z coordinate there is used the adjusting screw 8 of a commercially-available type of adjustable stage (slide table) 9 which, in the embodiment shown in Figures 1 to 3, serves as a specimen slide, while with the adjusting device as shown in Figure 4, the upper angle piece 5 itself serves as the specimen slide. In so far as in this case a displacement of the object in the direction of the Z coordinate is made possible, the adjusting device is, in turn, mounted on a corresponding adjustable stage (not shown).

In Figures 1 and 2, the support 1 of the adjusting device consists of a plane baseplate secured on a stand 10. To this, there is mounted at a parallel spacing, a horizontal leg 11 of the angle piece 3 disposed thereon with the aid of the hinged joint 2 connecting both parts. This hinged joint 2 preferably consists of a mechanically stable spring-plate which may be bent, for example, either in a Z- or U-shaped manner, or rectangularly, and is secured in the usual way with the aid of screws or rivets or by bonding or welding, to the baseplate and the angular piece 3. The respective vertical legs 12, 13 of the two angle pieces 3, 5 placed into one another with a spacing therebetween, are connected to each other by means of a hinged joint 4 consisting substantially of a plane springplate. If so required, of course, the springplates may also be bent in such a way that the moving part is pressed with a pretension against the relatively stationary part.

The adjustable stage 9 as disposed on the upper angle piece 5, comprises a holder or coverplate 14 which, in the embodiment shown, is provided with a V-shaped groove serving as the receptacle 15 for the object to be adjusted. When a commercially-available type of adjustable stage 9 is used, the vertical legs 12, 13 of the two angle pieces 3, 5 are as a rule, dimensioned to have such lengths that the axis of rotation of its hinged joint 4 is horizontally in a plane extending in parallel with the centreline of the objects to be adjusted and which are later on to be retained in the receptacle. If so required, interchangeable holders or coverplates may be provided, or alternatively separate receiving devices which are adapted to the various circumferential shapes or contours of objects which often have to be adjusted or positioned.

The adjusting screws 6, 7 which serve to perform the swivel movements of the angle pieces, are disposed within the area of the free leg ends 11, 16 and are preferably provided with a fine thread. The adjusting screws 6, 7 may have various arrangements which are primarily determined with a view to as practical as possible handling.

In the embodiment shown in Figures 1 and 2, the

support 1 or the baseplate of the stand 10 has a tapped hole with an adjusting screw 6 screwed in from the base side of the stand 10, this screw 6, when actuated, engaging upon the bottom side of the angle-piece leg 11 disposed thereabove, and effecting a displacement of the object in the direction of the X coordinate. The adjusting screw 7, which serves to displace the object in the direction of the Y coordinate is, however, screwed from above into a tapped hole in the upper angle-piece leg 16, abutting on the leg 11 of the angle piece 3 positioned therebelow.

Figure 3 shows an adjusting device in which the adjusting screw 6 serving to displace the object in the direction of the X coordinate, is also capable of being actuated from above. This screw passes through a larger diameter hole 17 provided in the horizontal leg 16 of the upper angle piece 5, and is screwed to such an extent into a tapped hole in the lower angle-piece leg 11 that its end abuts on the support 1. This support 1 may, for example, form part of an optical bench. The hinged joints 2, 4 in this case each consist of one plane spring plate.

Figure 4 shows an embodiment of an adjusting device with the object to be adjusted being an optical lens 18 seated in a socket 19 which, instead of an adjustable stage, is mounted directly to the upper angle piece 5. The lower angle piece 3 contains a through hole with an adjusting screw 6 inserted from above, which is screwed into a tapped hole in the support 1 positioned therebelow. This adjusting screw 6 serves to displace the object in the direction of the X coordinate.

The adjusting screw 7 serving to displace the object in the direction of the Y coordinate, is seated in a through hole provided in the free leg 16 of the upper angle piece 5, and is likewise screwed from above into the tapped hole provided in the horizontal leg 11 of the lower angle 6. The legs 11, 16 of the angle pieces 3, 5, while extending parallel in relation to the support 1, may each still contain a tapped hole with a locking screw 20, 21 for fixing the adjusted position. Considering that the legs 11, 16 of the angle pieces 3, 5 to be actuated by the adjusting screws 6, 7 have through holes, the adjusting screws, if so required, may each be provided with a retaining disc which, during the unscrewing of the adjusting screws 6, 7, serve as drivers.

In the present embodiment both the support 1 and the first angle piece 3 thereabove consist of a single part whose hinged joint 2 is produced by milling two slots extending in a horizontal plane leaving a land portion between them. In cases where the baseplate and the angle piece consists of two separate parts, these parts can likewise be connected with the aid of a web-shaped hinged joint. For this purpose there is used a flat spring plate which is led on two sides into corresponding slots (not shown) provided in the support 1 and in the angle-piece leg 11.

In order to obtain maximum adjusting results, it is the intention that the paths along which the object is to be displaced resemble as closely as possible those of orthogonal movements. Therefore, both the object and the swivel axes are positioned in such a way that the coordinates thereof form the corner points of a right-angled triangle, with the length of the swivel axis forming the hypothenuse of the triangle. For this reason, in all the embodiments of the adjusting device, the movable hinged joint 4 comprising the first swivel axis, is disposed in the apex of the angle α and the stationary hinged joint 2 comprising the second swivel axis, is disposed in the apex of the angle β. Moreover, the object receptacle is designed in such a way that the centre line of the object to be adjusted will come to lie almost in the apex of the righthand angle γ.

With the aid of such an adjusting device it is possible to effect a translational movement of optical elements in two coordinate directions, with the displacement paths thereof lying within the range extending from micrometers to millimeters. No precision parts are required for this purpose. The individual parts of the device can be manufactured with generally customary manufacturing tolerances and are subjected to practically no wear.

The adjusting device needs no maintenance, is insensitive to soiling and has therefore, a long service life. In cases where locking screws are used, the arrested position has a good vibrational and impact strength. Owing to the unusually simple construction and its mechanical robustness, the adjusting device is in particular also suitable for being used as a positioning device in a splicing facility for connecting the ends of optical fibre waveguides.

CLAIMS

1. Adjusting device for the antibacklash displacement of objects (specimens) in a coordinate system having at least two displacement paths, such as for aligning the end faces or longitudinal axes of optoelectronic components and/or optical fibres, of the kind in which the object (specimen) to be positioned is capable of being moved with the aid of adjusting screws, about the axis of a first swivel member lying next to the object (specimen), which swivel member is, in turn, capable of being moved about the axis of a second swivel member mounted in a rocker-like manner on a firm support, lying at a distance in parallel under the object (specimen), characterised in that the swivel members consist of two angle pieces (3, 5) which fit into one another with a space between them, each having a leg (11, 16) extending in parallel with the support (1), of which the lower leg (11), via a hinged joint (2) forming the second swivel axis, is connected stationarily to the support (1), the ends of the respective other leg (12, 13), via a hinged joint (4) forming the first swivel axis, are connected to one another, and the free leg ends of the angle pieces (3, 5) are each capable of being actuated by an adjusting screw (6, 7) for performing the swivel movements.

2. An adjusting device as claimed in claim 1, characterised in that an adjustable stage (9) is provided on the leg (16) of the upper angle piece (5) extending parallel in relation to the support (1), and that the hinged joint (4) connecting the vertical legs (12, 13) of the two angle pieces (3, 5), as well as the centreline of the object receptacle (15) are disposed in one plane.

3. An adjusting device as claimed in claim 1, characterised in that the hinged joints (2, 4) consist of spring plates.

4. An adjusting device as claimed in claim 1,

characterised in that the support (1) as well as the angle piece (3) disposed thereon, are made in one piece comprising two diametrically cut-in slots (22) leaving between them a web or land portion forming the hinged joint (2).

5. An adjusting device as claimed in claim 1, characterised in that the lower angle piece (3) can be readjusted with respect to the support (1) by means of an ajusting screw (6) seated in the support (1).

6. An adjusting device as claimed in claim 1, characterised in that the lower angle piece (3) can be readjusted with respect to the support (1) by means of an adjusting screw (6) seated in the free leg (11) of the lower angle piece (3).

7. An adjusting device as claimed in claim 1, characterised in that the upper angle piece (5) can be readjusted with respect to the lower angle piece (3) by means of an adjusting screw (7) seated in the free leg (16) of the upper angle piece (5).

8. An adjusting device as claimed in claim 1, characterised in that the upper angle piece (5) can be readjusted with respect to the lower angle piece (3) with the aid of an adjusting screw (7) seated in the free leg (11) of the lower angle piece (3).

9. An adjusting device as claimed in any one of claims 1 to 5, characterised in that the legs (11, 16) disposed parallel in relation to the support (1), of the two angle pieces (3, 5), each contain one locking screw (20, 21) for locking the adjusted positions.

10. An adjusting device as claimed in any one of claims 1 to 9 forming part of a device for splicing together the ends of two optical fibres.

11. An adjusting device substantially as described with reference to the accompanying drawings.

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